Research Proposal

Wisconsin Department of Transportation

Wisconsin Highway Research Program (WHRP)

Submitted by

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UNIVERSITY OF WISCONSIN-MILWAUKEE
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Proposal Title:

BRIDGE INTEGRATED ANALYSIS AND DECISION SUPPORT: Case Histories

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BRIDGE INTEGRATED ANALYSIS AND DECISION SUPPORT - Case Histories

INTRODUCTION AND PROBLEM STATEMENT

Highway bridge structures constitute the lifelines of our nations economy. They provide an important transportation means for flow of commerce and for the every day needs of the traveling public. With the aging of these structures, bridge owners and engineers have experienced serious problems of deterioration and diminishment of functionality. Although it is work in progress, over the last several years, bridge engineers have made significant advances in assessing the conditions of in-service bridge structures and in providing remedial services to offer safe operation of these structures. The problems associated with the aging and deterioration are sometimes magnified by unforeseen events, such as natural disasters, as well as accidents/incidences that are caused by human errors or intentional acts of terror. Examples of unforeseen events include vehicle and ship impacts on bridge elements, overloads, explosions, acts of terror, and natural disasters such as earthquake, extreme cold weather conditions, scour, tornado, and fire. These could lead to a compromise of the structural integrity that could result in catastrophic failures, loss of lives, economical losses, and disruption of traffic and inconvenience. When faced with these problems, rapid response and mitigation become necessary. Bridge owners and engineers have a crucial role in making timely and appropriate decisions to address these problems and to minimize the resulting adverse effects. To achieve success in responding to unexpected emergencies, bridge owners and engineers must have appropriate training and be prepared well in advance. Appropriate tools must be developed to assist bridge owners and engineers in the decision making process. These tools must be developed based on modern engineering principles as well as the knowledge from previous experiences. The most appropriate tool to be used is the concept of decision support system that is tailored to transportation emergency response and transportation management and maintenance. An effective decision support system contains different components and it incorporates all relevant information, including bridge structural and maintenance records and histories of past emergency cases, with modern engineering analysis and design as well as probabilistic modeling and decision support methods. Different components of this important tool may be developed independently, but with the goal that they must be integrated into the intended decision support system. One important part of a transportation decision support system is the knowledge from previous experiences where emergency responses were required. This knowledge will become the foundation for future decisions and actions under similar conditions. In addition, a collection of these past experiences within Wisconsin and elsewhere can be very valuable to Wisconsin bridge owners and engineers as a stand-alone resource that may be used prior to being incorporated into the decision support system. It is the goal of this study to develop an easy-to-use document that contains such information. While the emphasis will be placed on Wisconsin past experiences, relevant information from other states and elsewhere will also be included in the document.

RESEARCH OBJECTIVE and SCOPE

The primary objective of this study is to develop an easy-to-use but comprehensive document that will include case histories or previous experiences in Wisconsin and elsewhere for bridge problems when emergency responses were required to mitigate them. A minimum of ten structures that will encompass the breadth of bridge types and materials within Wisconsin will be selected and included in the study, although efforts will be made to collect as many Wisconsin case histories as possible. The selected cases will include the most common damage and failure types within the state. Additional five to ten structures outside of Wisconsin will be selected and included in the study, if relevant and useful case histories are discovered during the period of this project. The document will be prepared in an electronic reference format and will include elements organized in a narrative with hyperlinks to the supporting documentation. Although only limited number of case histories will be documented in this study, the research staff will develop an interactive question and answer feature that can offer recommended actions based on the available information and past experiences for similar situations. However, the document will be prepared with the goal that it can be expanded easily to include additional case histories in the future. This can, in turn, enhance the knowledge base for the interactive question and answer feature to yield more reliable recommendations.

BACKGROUND AND SIGNIFICANCE OF WORK

Bridge management and maintenance programs, including repair and rehabilitation efforts and making appropriate decisions in an emergency situation, can be effective only when they are based on accurate and reliable information on the condition of the structure and other relevant knowledge. Currently, such information or capability either does not exist in a collective form or is not easy to obtain. Response to emergency bridge problems are often difficult since there is generally little response time and the inherent urgency of the situation, such as when there is a likelihood of a catastrophic structural failure. A well-known example of such a case with an urgent need for bridge condition assessment and quick decision-making is the cracking of steel girders at the Daniel Webster Hoan Bridge in Milwaukee during the winter of 2000, Figure 1. In this case, although the involved WisDOT engineers were trained and skilled in various aspects of bridge analysis, design, construction, and general structural behavior of the bridge, the characteristics of the problem and its urgency created a significant challenge that required special attention. Numerous other emergency cases have been experienced in Wisconsin and other states where bridge owners and engineers are faced with such difficult challenges. The November 2002 impact of a truck on the piers of a local bridge carrying traffic over the Interstate-94 in Menomonee, Wisconsin is an example of a transportation crisis. In this case, due to the extensive damage and failure of the piers, both lanes of the interstate, normally carrying approximately 25,000 vehicles per day, had to be closed and the traffic was diverted through the City of Menomonee, causing major delay and disruption for the city residence and traveling public. An emergency case had to be declared by the local District Director and WisDOT personnel had to make critical decisions to rapidly bring the Interstate Highway back to normal service condition. An example of a transportation crisis in a regional state is the October 2001 destruction of an I-44 overpass bridge in Lebanon, Missouri, from the impact of a 13-ft diameter by 32-ft long high pressure tank being hauled on a trailer. The severe impact caused four 3-ft deep beams to excessively bend up to eight feet and it totally removed these girder support elements from the under side of the bridge deck, Figure 2. The traffic on both directions had to be diverted to alternate routes and after a thorough, but quick, engineering investigation was completed, it was decided to reconstruct the bridge's superstructure due to the extensive damage caused by the impact. The truck driver in this case was cited for violating a MoDOT special permit that prohibited him from following this route with the overpass. Although this is a case outside of Wisconsin, the relevant information for this and similar incidents will be valuable to Wisconsin bridge owners and engineers. The benefits from these experiences, documented either as stand-alone or as a part of a decision support system for bridge management and maintenance, are clear as they provide immediate and up-to-date information to assist the bridge owners and engineers to arrive at appropriate decisions and responses.

Figure 1 – Cracking of a fracture critical girders
(Hoan Bridge, Milwaukee, WI)

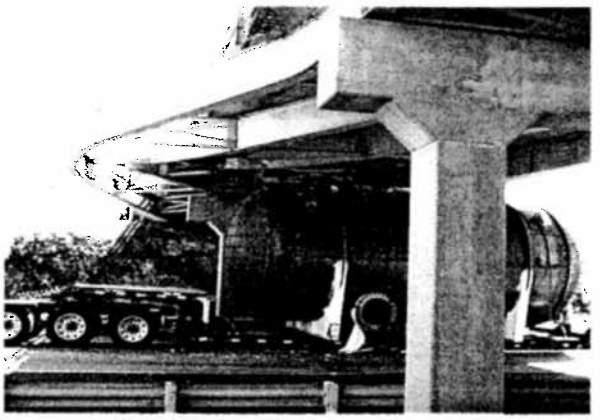

Figure 2 – Impact of a Vehicular load on bridge girders
(I-44 Overpass, Lebanon, MO)

Cases that require emergency response are not limited to those resulted only from accidents and natural disasters. Bridge owners and engineers are now also faced with the possibility of unforeseen bridge damage and failure due to terrorism. Security consideration and vulnerability assessment has become an important part of bridge management. Development of a decision support system for bridge structures must also include issues related to security and associated emergency responses. A number of bridge security related initiatives have already been

started and work is in progress at the national and local levels. AASHTO, NCHRP, and FHWA are coordinating their efforts with various states to address two primary themes related to infrastructure security. These efforts include:

- Critical infrastructure protection, and
- Emergency responses and operations.

Under the infrastructure protection and emergency response themes, it is envisioned that a number of new initiatives will be implemented. These initiatives include creating or developing transportation management centers that operate with the aid of decision support systems, state-of-the-art bridge security and surveillance techniques, incidence surveillance monitoring and detection, communication systems, traveler information, traffic control devices, research funding to develop new capabilities in design of bridges for security, and in rapid bridge replacement and repair techniques. These efforts are intended to assist bridge owners and engineers to make appropriate and timely decisions, and to offer rapid responses in cases of unforeseen and emergency crisis. The results of these initiatives can also be incorporated into a broader bridge integrated analysis and decision support system.

Over the last several decades, the concepts of computational decision theory have been used to develop decision support systems with different applications. A bridge integrated analysis and decision support system for managing and maintaining bridge structures may be developed to aid engineers in making appropriate and timely decisions in the field and in cases that require emergency responses. The system must incorporate all relevant information, including past experiences, with modern analysis and design concepts as well as appropriate probabilistic modeling and decision support methods. For the system to be effective, it must include information from a number of separate but integrated components. Information related to these components form a comprehensive database in support of the probabilistic modeling and decision support approaches that are used in the system. These integrated components include:

- Bridge inventory
- Bridge maintenance records
- Bridge monitoring records
- Bridge security records and consideration
- Case histories
- NDE capabilities (with probabilistic approach) and vendors
- Required support staff and equipment
- Analysis and design capabilities for sub- and super-structures
- Alternate routing options
- Warning systems for various possible damages
- Bridge vulnerability assessment tool
- Coordination needs with other authorities and agencies
- List of outside expert consultants and information related to their qualifications
- List of engineers and contractors who are qualified to perform necessary emergency services
- Expert system

All of the components listed above contribute to the effectiveness of the bridge integrated analysis and decision support system and must be incorporated in the system. Clearly, incorporating the above listed components in a decision support system will require a major effort. It is more reasonable and practical to acquire and assemble relevant information for each component separately but in such a way that it can be integrated easily into the decision support system. Information relevant to several of the listed components, such as bridge inventory, maintenance records, agency coordination, support staff, consultants and contractors lists, and alternate routing options, are generally available or may be obtained readily from different sources and only need to be archived in appropriate formats to allow its integration into the decision support system. However, information relevant to some of the other listed components will require more significant efforts for its acquisition and integration into the decision support system. One important component of the decision support system that requires efforts to be acquired is the knowledge of past emergency response related experiences. These experiences will become the

foundation of forming future decisions and actions. Accordingly, the primary objective of this study is to develop a comprehensive electronic, but easy-to-use document, that will contain past bridge problem experiences in Wisconsin and elsewhere where emergency responses were required and exercised. It is envisioned that future studies will add other required components to the bridge integrated analysis and decision support system as appropriate. As a part of meeting the objective of this study, the research team will work closely with WisDOT personnel from various districts as well as others from other states to document their past bridge problem and response experiences. This will be accomplished through face-to-face meetings, telephone conversations, and correspondence. It may also be necessary for the research team to travel to various DOT offices to search archived documents to acquire the relevant information regarding past experiences for various bridge structures. The breadth of bridge types and materials as well as the more common failure types, rather than the uncommon ones, in Wisconsin will be included in the study. The principal investigator for this proposed study has recently completed thorough literature searches in the areas of interest to this proposed study. These efforts were made in support of two separate recent studies sponsored by the WisDOT. One search produced documentation to describe common defects and problems in different bridge structures and to recommend appropriate NDE test techniques [(1)]. The second search provided information on repair methods for failures and deteriorations in concrete bridge structural members within Wisconsin [(2)]. The final reports for these studies contain the results of the literature reviews and list relevant references, specifications and standards.

This proposed study will include Wisconsin case histories for steel and concrete girder bridges, timber bridges, fracture critical elements in steel bridges, truss bridges, and moveable bridges. Where past experiences from other states are found to be relevant to the needs of Wisconsin bridge owners and engineers, they will be discussed with appropriate WisDOT personnel so Wisconsin's mission and approaches can be incorporated in the resulting document, as appropriate. The past experiences of DOT personnel from the neighboring and regional states could be invaluable as they share similar bridge types, traffic patterns, and environmental conditions. The PI for this proposed study is a member of the Midwestern DOT Group that meets annually to address common regional bridge and highway problems and to explore possible solutions to these problems. Through contacts with the members of the Midwestern DOT Group, past experiences of the DOT personnel from the region will also be collected and included in the document as appropriate. In addition, the research team includes Mr. Phil Fish who has recently retired from WisDOT after over thirty years of service in bridge maintenance, inspection, and rehabilitation. Mr. Fish is a nationally recognized authority and has direct experience and knowledge related to various Wisconsin cases when emergency responses were required and provided. Mr. Fish's knowledge and experience will complement this study, as it will be an invaluable asset.

BENEFITS

This proposed study will result in the creation of a valuable resource/document that can be used and referenced by Wisconsin bridge engineers when rapid responses are required for emergency bridge problems. The document will contain case histories and past practices and experiences regarding bridge problems in Wisconsin and other states when rapid responses were required and exercised. The document will be prepared in an easy-to-access electronic format that can be expanded with additional case histories and experiences in future. The benefits from this resource are important in light of the fact that it will retain the valuable and relevant knowledge of past practices and experiences of skilled WisDOT personnel as they retire from their positions. Considering the enormous consequences of unforeseen bridge damage or failures, the results of this study will provide benefits to the state of Wisconsin in terms of assuring public safety, minimizing the disruption of the flow of traffic and commerce through our roadway system, and facilitating our long-term economic development.

IMPLEMENTATION

This study will develop easy-to-access electronic and printed reference/training materials to facilitate rapid responses to bridge emergency problems in Wisconsin for the purpose of mitigating the resulted damage. Bridge design and maintenance personnel may use these materials to enhance their current practices as appropriate. To implement the results of this study, publicity on the availability of the materials will be required. In collaboration with the WisDOT officials, the research team will be prepared to help publicize the results of the study through

presentations and speaking engagements at various WisDOT, regional or national meetings or events. At the discretion of the WisDOT, the study's results and findings could also be placed on the World Wide Web for global access.

DETAILED WORK PLAN

The work plan presented here describes the research team's proposed approach to accomplish the objectives of this study. It is proposed that an Advisory Committee be appointed to consult with the research team on technical aspects at the initial and subsequent stages of this study.

The objectives of this study will be accomplished through performing the following tasks.

TASK A – Review of Available Literature

Efforts will be made to review available literature related to highway bridge problems that have required emergency responses to mitigate the resulting damage. Relevant information sources that contain case histories of bridge accidents and problems in Wisconsin and elsewhere will be reviewed for documentation. The review will include local, regional, national, and international sources in the forms of personal experiences of appropriate bridge engineers and maintenance staff, bridge maintenance records, departmental reports, technical and professional articles in magazines and journals (ASCE, ACI, PCI, etc.), major technical reports of studies sponsored by various State Departments of Transportation, FHWA, and NCHRP, international media sources, university libraries, on-line libraries, and other web sources. The primary emphasis will be placed on information that is relevant to Wisconsin bridges and accepted practices. However, useful information may also be obtained from cases that have occurred elsewhere. All information and documents related to condition assessment techniques, analysis methods, failure investigation, emergency and long-term retrofit and rehabilitation methods, traffic control issues, budget issues, and other construction and repair work will be included in the document. The document will consist of summary reports of historical background, administrative and government involvements and decision making, photographs, video, sketches, contract drawings, specifications, cost information, tie requirements, and other useful information.

TASK B – Identification and Collection of Case Histories in Wisconsin

In addition to reviewing the routine sources of literature, experienced bridge engineers and maintenance personnel in bridge offices in various Wisconsin DOT Districts will be contacted and visited if necessary, to solicit and document their past experiences relevant to bridge failure cases that required rapid responses to mitigate the problems. This effort will be made in collaboration with appropriate WisDOT officials so individuals with knowledge of past bridge problems and emergency cases can be identified and contacted for this task. If necessary, the research team will travel to various WisDOT offices to conduct searches on available maintenance records and other archived materials to document case histories of bridge problems that required emergency responses. At a minimum, ten case histories of bridge problems with emergency responses in Wisconsin will be collected and documented. Attempts will be made to include additional cases in the study if they are identified. An emphasis will be placed on selecting case histories that encompass bridge and failure types that are most common to Wisconsin. All information and documents related to condition assessment techniques, analysis methods, failure investigation, emergency and long-term retrofit and rehabilitation methods, traffic control issues, budget issues, and other construction and repair work will be included in the document. The document will consist of summary reports of historical background, administrative and government involvements and decisions, photographs, video, sketches, contract drawings, specifications, cost information, and other useful information.

TASK C – Identification and Collection of Case Histories Elsewhere

In collaboration with the WisDOT officials and the members of the Advisory Committee for this proposed study, bridge engineers and maintenance personnel from states outside of Wisconsin will be identified and contacted to document their past experiences when emergency responses were required to address unexpected problems in bridges. The emphasis will be placed on contacting personnel from regional or neighboring state Departments of Transportation, as there are similarities with Wisconsin in terms of bridge types, traffic load patterns, and environmental conditions. Primary emphasis will be placed on contacting the members of the Midwestern DOT

Group with its membership mostly consisted of individuals from the Midwest regional state Departments of Transportation. Efforts will be made to select and document between five to ten case histories relevant to Wisconsin from the neighboring states and elsewhere. The selected case histories in this task will be based on consultation with appropriate WisDOT officials and the members of the Advisory Committee to ensure their relevance to Wisconsin bridges and accepted practices. All information and documents related to condition assessment techniques, analysis methods, failure investigation, emergency and long-term retrofit and rehabilitation methods, traffic control issues, budget issues, and other construction and repair work will be included in the document. The document will consist of summary reports of historical background, administrative and government involvements and decisions, photographs, video, sketches, contract drawings, specifications, cost information, and other useful information.

TASK D – Assembly of Collected Case Histories in Electronic Form
All selected case histories in the study will be documented in an electronic reference format that may be integrated into a subsequent decision support system. The document will be prepared in a narrative form with various relevant elements that will have hyperlinks to supporting documents. The document will have a key word search features with all relevant document links. Since it is important to include future case histories in the electronic document, steps will be taken to facilitate its expansion as necessary.

A number of database software packages are commercially available that will allow the creation of an easy to use electronic reference document on bridge case histories. These include Microsoft Access, File Maker, Alpha Five, Quest Central, DB One, DB query, etc. An evaluation of the available database packages will be made at the initial stages of the study to identify and select the most appropriate one for this study. The primary consideration in the selection of the database software package will be the ease of future expansion and use as well as its compatibility with various data forms such as text, sketches, photographs, audio, video, etc.

TASK E – Develop Basic Elements of an Expert System Based on Past Experiences
An effort will be made to integrate the electronic database developed in Task D into an expert system to provide recommendations on appropriate course of actions in cases where rapid response will be required to address bridge emergency incidents. This effort will be an extension of the current work of the PI from another study that has been recently completed for WHRP[(2)]. In the recent WHRP study, a database of concrete bridge deterioration cases have been integrated into a commercially available expert system software called "CLIPS" to offer recommendations for rehabilitation of concrete bridge structures. The Visual Basic software is used as an interface to offer ease of use for the expert system. It is proposed that a similar approach be used in this study to develop a similar expert system but based on the case history database developed under Task D. It must be understood, however, that the system will only offer the basic foundation for a more comprehensive future system when an adequately large database with additional case histories is constructed.

TASK F – Final Report and Electronic Reference Media
The results of this proposed study will be documented in both print and electronic reference media. The print media will be in the form of a final report that will document detailed results of all of the tasks of the study. These will include results from the literature review, narratives for various Wisconsin and other case histories, supporting documentation, and a user's guide for the electronic reference document. The electronic reference media will be distributed on compact disks (100 copies) and will include searchable case histories with hyperlinks to supporting documents as well as the expert system.

REFERENCES
1. Ghorbanpoor, A., and Benish, N., "Non-Destructive Testing of Wisconsin Highway Bridges," Final Report, Wisconsin Department of Transportation, Contract # 0092-00-15, March 2003, 103 pages.
2. Tabatabai, H., Ghorbanpoor, A., and Turnquist, A., "Rehabilitation Techniques For Concrete Bridges," Draft Final Report, Wisconsin Department of Transportation, Contract # 0092-06, March 2004, 309 pages.

WORK TIME SCHEDULE

A period of two years is proposed for the completion of all tasks of this study. The proposed starting date for this study is September 1, 2004. The following table shows a timeline for all of the tasks that are required to achieve the objectives of the study.

MONTHS / TASKS	3	6	9	12	15	18	21	24
A. Review of Available Literature	———							
B. Identification and Collection of Case Histories in Wisconsin	———	———	———	———	———	———	———	
C. Identification and Collection of Case Histories Elsewhere	———	———	———	———	———	———	———	
D. Assembly of Collected Case Histories in Electronic Form		———	———	———	———	———	———	
E. Develop Basic Elements of an Expert System Based on Past Experiences			———	———	———	———	———	
F. Final Report and Electronic Reference Media							———	———

REPORTS

Following reports will be submitted:

- Quarterly Progress Report – Quarterly progress reports will be prepared and submitted at the conclusion of each calendar quarter. The reports will include all aspects of the study including accomplishments, results, difficulties or problems, and plans of work for the following quarter.
- Final Report and Electronic Reference Media – Thirty days prior to the completion date of this study, a draft final report will be submitted to the WHRP for review and comments. After receiving and incorporating comments from the DOT, a final report will be prepared and submitted before the completion date of the contract. At the time of the submission of the draft final report, the electronic reference media and the expert system, as described under Tasks E and F, will also be submitted for review and comments. Revisions will be made to the submitted materials based on the received comments before the final submission.

BUDGET REQUIREMENTS

The following table shows the required budget for the proposed study.

Budget Categories	**WHRP Cost:**			**UWM Cost Share:**		
	Year 1	**Year 2**	**Total**	Year 1	Year 2	Total
1. Salaries						
a) Al Ghorbanpoor, P.I. (4.25 mos)	**11,750**	**12,220**	**23,970**	13,219	13,748	26,967
b) Grad Student (33% time for 2 years)	**14,437**	**15,014**	**29,451**			
c) Student Hourly (160 hrs)	**640**	**640**	**1,280**			
Subtotal	**26,827**	**27,874**	**54,701**	13,219	13,748	26,967
2. Fringe Benefits						
a) Al Ghorbanpoor (33%)	**3,878**	**4,033**	**7,910**	4,362	4,537	8,899
b) 1. Grad St Fee Remission (25%)	**3,609**	**3,754**	**7,363**			
2. Grad St Fringe Benefits (25%)	**3,609**	**3,754**	**7,363**			
c) Student Hourly (2.5%)	**16**	**16**	**32**			
Subtotal	**11,112**	**11,556**	**22,668**	4,362	4,537	8,899
3. Consultant - Philip Fish (80 Hours)	**2,400**	**2,400**	**4,800**			
4. Operating Expenses						
a) Office supplies	**500**	**500**	**1,000**			
b) Report & Electronic media	**287**	**1,500**	**1,787**			
Subtotal	**787**	**2,000**	**2,787**			
5. Travel	**1,500**	**500**	**2,000**			
6. Subtotal	**42,626**	**44,330**	**86,956**	17,581	18,285	35,866
7. Indirect Cost (15%)	**6,394**	**6,650**	**13,043**	2,637	2,743	5,380
8. Total	**49,020**	**50,980**	**100,000**	20,218	21,028	41,246

BUDGET EXPLANATION

1. Salaries:
Al Ghorbanpoor, PI, 1.0 months for each year is charged to WHRP and 1.125 months per each year is UWM's cost share to this study; Graduate Research Assistant, 33% appointment for each full year; hourly undergraduate student, 80 hours for each year. The salary items for the PI and Graduate Assistant are increased 4% for year 2.

2. Fringe Benefits:
The UWM fringe benefit rates are 33% for faculty (PI), 25% for graduate research assistants, and 2.5% for hourly undergraduate students. The University of Wisconsin System also requires that a fee of 25% of the student's salary is assessed for remission of out-of-state tuition.

3. Consultant:
Philip Fish of Fish Inspection & Testing, LLC, will serve as a consultant to this study. Mr. Fish will contribute to this study through assisting the research team in obtaining appropriate past experiences when rapid responses were required. A total of 80 hours has been considered for this effort.

4. Operating Expenses:
These include office supplies (consumables, computer software, etc.) and reports and electronic media.

5. Travel:

Travel expenses include those associated with visits that will be made to various WisDOT offices, and possibly to other regional states, for face-to-face interviews or on-site search of records to collect information and documents regarding past experiences.

7. Indirect Cost:

The special reduced indirect cost (Facilities & Administration) rate for the WHRP is 15% of the total direct cost. The normal indirect cost at the university is 47%.

QUALIFICATIONS OF RESEARCH TEAM

Dr. Al Ghorbanpoor - Dr. Al Ghorbanpoor will serve as the Principal Investigator for this proposed study. He is currently a Professor of Structural Engineering at UWM where he has taught undergraduate and graduate level courses and conducted research in the areas of non-destructive evaluation, rehabilitation, failure investigation, design, and fatigue and fracture of bridge structures since 1986.

Dr. Ghorbanpoor has served as the Principal Investigator on several bridge NDE, fatigue and fracture, and rehabilitation research studies funded by the U.S. DOT and various State Departments of Transportation including Wisconsin DOT and WHRP. His research activities in the area of evaluation of bridges have focused on developing new test techniques, instrumentation, and specifications, as well as field applications of existing and the newly developed techniques for both concrete and steel bridges. He has recently (2003) completed a study, "Non-Destructive Testing of Wisconsin Highway Bridges," sponsored by the WHRP that includes a survey of possible defects and problems in concrete and steel bridges and a recommendation for applicable evaluation techniques. The final report of the study has been approved and is under print. In recent years, Dr. Ghorbanpoor has developed instrumentation and test techniques for the impact-echo method to detect defects and voids in concrete and post-tensioning ducts, and for the magnetic flux leakage method to detect and assess the severity of corrosion in prestressing and post-tensioning steel within concrete structures. In 1983, he conducted one of the first major research studies to apply the acoustic emission (AE) NDE test method to steel bridge structures. That study was sponsored by the US DOT and included the application of acoustic emission to the Woodrow Wilson Bridge in the Washington, D.C. Metro area. The study demonstrated for the first time that it was possible to perform quantitative field monitoring of fatigue cracking in steel bridges under service conditions. In 1993, Dr. Ghorbanpoor also completed a Wisconsin DOT sponsored research study involving application of acoustic emission in steel bridges in the Milwaukee area.

Dr. Ghorbanpoor has developed and now teaches a graduate level course at UWM on the design and rehabilitation of highway bridge structures. Elements of the NDE and general evaluation of bridge components and structures are covered in the course. Over the past 10 years, he has developed several professional development courses and seminars in the area of bridge evaluation. These course/seminars have been offered at different locations throughout the United States. Dr. Ghorbanpoor is also the Director of the NDE and the Structural Engineering Laboratories at the College of Engineering and Applied Science at UWM.

Dr. Ghorbanpoor earned a Ph.D. degree from the University of Maryland in 1985. Prior to joining UWM, Dr. Ghorbanpoor was the Chief Structural Engineer for two years at the firm of IPDS, Ltd., Silver Spring, Maryland. He also was employed for six years as a practicing design engineer with the consulting engineering firm of Whitney, Bailey, Cox and Magnani in Baltimore, Maryland. During his eight years of professional engineering practice, Dr. Ghorbanpoor was engaged in the design, construction, evaluation, and rehabilitation of various bridge and building structures. Since then, he has served as a consultant to the U.S. DOT, several State Departments of Transportation, and various engineering organizations in the U.S. and abroad to evaluate the condition of various bridge and building structures.

Dr. Ghorbanpoor has served as the member, secretary, and Chair of several national and international technical committees including ASCE, ACI, PTI, ASNT, RILEM, and TRB. He is a registered Professional Engineer and a Fellow of the American Society of Civil Engineers.

Through classroom education and laboratory and field research in the areas of highway bridges and non-destructive evaluation or testing, a large number of graduate students at the Department of Civil Engineering at UWM have gained significant knowledge and experience in the field of bridge evaluation. This provides an excellent opportunity for engaging a knowledgeable and experienced Graduate Research Assistant to successfully carry out a major part of this proposed research.

Mr. Philip Fish – Mr. Fish will serve as a consultant to the research staff for this proposed study. His primary role will be to assist the research team with identifying cases in Wisconsin and elsewhere when emergency responses were required to mitigate the resulting problems. Mr. Fish has extensive personal knowledge of such cases in Wisconsin as he was directly involved with the WisDOT bridge maintenance operations for 34 years until 2002. Among his many contributions to bridge evaluation in Wisconsin is his major role in the emergency failure investigation and damage mitigation for the Hoan Bridge in 2000. Mr. Fish will also assist the research team to identify and contact other individuals and offices with involvement in similar cases in Wisconsin and elsewhere.

Mr. Fish has over 36 years of broad technical background and experience in inspection, analysis, and rehabilitation design of bridge structures, industrial structures, building structures, sign structures, high mast light poles, and other miscellaneous structures. In addition, he has developed inspection and testing procedures for the automotive industry and performed inspections on crane booms, custom-built semi trailers, and numerous temporary shoring systems for bridges.

Mr. Fish implemented the Fracture Critical Bridge Inspection program for the Wisconsin Department of Transportation and developed an inspection policy and procedures for inspection of major "Fracture Critical Bridges". He has performed nondestructive testing and inspection on numerous structures. Mr. Fish has performed analysis on fatigue susceptible connections and welds in addition to failure analysis on failed members. He also has directed fabrication quality assurance programs for fabrication of major steel and mechanical bridges. He supervised the certification of "Certified Weld Inspectors" and "Nondestructive Testing Evaluators". He also supervised construction and rehabilitation of major steel bridges in the field. Mr. Fish has lectured on numerous technical professional development seminars and courses, published several papers on inspection and nondestructive evaluation of bridge structures, and served on several on technical committees for the Federal Highway Administration and various technical societies.

Mr. Fish has submitted a letter of interest to participate in this study. The letter is attached to this proposal.

AVAILABLE FACILITIES

The College of Engineering and Applied Science at UWM provides support for the research activities of its faculty and staff through making available research laboratories, computing facilities, as well as state-of-the-art library and literature search capabilities. In addition, library and various laboratory staff will be available to assist the UWM faculty members and graduate students during the course of their research studies. Although available, no specialized research laboratory facilities will be needed to accomplish the required tasks of this study. The available computer facilities, library and literature search capabilities, and relevant staff will be the primary source of support that will be used for this work.

The research team for this proposed study is experienced with overall evaluation of various types of bridge structures as well as with the required data archiving and expert system development. This experience will be important to successfully complete all tasks of this study.

Consultant's Letter of Interest to Participate

May 20, 2004

Dr. Ghorbanpoor,

This letter is to confirm the participation of Fish Inspection & Testing LLC, Sauk City, WI, in research proposal "BRIDGE INTEGRATED ANALYSIS AND DECISION SUPPORT – Case Histories" for Wisconsin Department of Transportation.

Decision support system would be an excellent tool to assist Bridge Engineers in emergency situations. Bridges are damaged by impact, fire, shipping vessels, and scour to name a few. Types of bridges damaged include concrete, steel and sometimes wood.

My intent for participation in this research proposal would be to assist in the collection of past experiences related to immediate response needs for bridges within Wisconsin and outside of Wisconsin. This may include cases where bridges were damaged due to truck or ship hits, fracture of steel members, scour, and other incidents as applicable to this proposed research.

Fish Inspection & Testing LLC fees for professional services range from $80.00 to 100.00 per hour. For this project, the fee for professional service will be $60.00 per hour due to the limited budget available and my personal interest in the development of a decision support system for rapid response situations.

Certificates of insurance for personal liability, professional liability, equipment, auto, aerial, and worker compensation are available on request.

I appreciate the opportunity to participate in this proposed research.

Sincerely,

Philip Fish
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Sauk City, WI 53583
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